APPENDIX 3.14A

Model Results for Predicted Drawdown and Effects on Migration of Groundwater Contaminants, for Proposed Pumping at Highgrove

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MEMORANDUM

DATE	June 14, 2007
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PROJECT NAME	AES Highgrove - CEC Permitting Support
PROJECT NO.	N0636A
SUBJECT	Model Results for Predicted Drawdown and Effects on Migration of Groundwater Contaminants, for Proposed Pumping at Highgrove
FILE LOC	Reno

Background

The objective of this evaluation is to assess the potential effects of proposed pumping of groundwater for the proposed Highgrove project including:

- the estimated drawdown on neighboring wells within 0.5 mile of the proposed well(s)
- any effects on the migration of groundwater contaminants from the proposed pumping, and
- the likelihood of any changes in existing physical or chemical conditions of groundwater resources

Summary of Modeling Results

This evaluation is based upon proposed pumping rates of 183 acre-feet/year from an onsite well and an additional 183 acre-feet/year from the nitrate-impaired Spring Street wells. Based on the computer modeling described below, this pumping will generate 2 to 3 feet of drawdown in neighboring water-supply wells within one-half mile of the proposed pumping wells (see Figure 1, all figures are being submitted under a request for confidentiality). These wells include: Van Buren 1 and 2, Riverside North #7, Gage UCR-MLK, Highgrove 1 and 3, and the Center Street well.

Nitrate is the primary groundwater contaminant in the area. Regional elevated total inorganic nitrogen (TIN) concentrations in groundwater are largely due to historical agricultural practices in the Santa Ana River Watershed (Santa Ana Regional Water Quality Control Board (8), 2004). The predominant agricultural uses in the area were citrus and dairy.

The proposed pumping will slightly influence the migration of groundwater contaminants, primarily within capture zones extending upgradient of each pumping well. To evaluate this effect, capture zones were calculated for the two wells using the computer modeling described below. Figure 2 compares the modeled capture zones with contours of nitrate in groundwater obtained from a 1997 regional nitrate map (Wildermuth Environmental, Inc., 1999). The impact on nitrate migration from the proposed pumping is interpreted to be minimal, because 1) the capture zones have maximum widths of only 560 and 460 feet, and 2) the capture zones extend into areas where ambient nitrate concentrations are relatively uniform. The proposed pumping will affect contaminant migration by gradually removing nitrate-containing groundwater from the areas within the capture zones.

In addition to estimating the drawdown on neighboring wells and potential effects on the migration of groundwater contaminants, this evaluation assesses the likelihood of any changes in existing physical or chemical conditions of groundwater resources. Due to the relatively small drawdown predicted in the surrounding area (2 to 3 feet after 10 years), in our opinion changes in physical conditions such as aquifer compaction will be insignificant. Due to the prediction that the capture zones are relatively narrow and extend into areas of uniform nitrate concentrations, chemical changes resulting from altered groundwater flow paths and the associated mixing of groundwater with potentially different compositions is expected to be insignificant also. Thus, it is considered unlikely that any significant changes in existing physical or chemical conditions of groundwater resources will occur as a result of the proposed pumping from the on-site and the Spring Street wells.

Summary of the Technical Approach and Input Data for Computer Modeling

1. Drawdown impacts in neighboring wells were estimated with an analytical model based on the Cooper-Jacob equation (Driscoll, 1986). Model parameters were obtained from the project AFC and confirmed by comparing with a modeling report generated for the City of Riverside (GeoTrans, 2003). The transmissivity of the on-site well, estimated to be 100,000 gallons per day per foot (AFC, 2006, Section 8.14.5.2), was assumed to be representative of the Spring Street well also. The transmissivity was adjusted to simulate the effect of the no-flow boundary conditions present at bedrock interfaces in the area by dividing by 2. The aquifer parameters used in the analytical model are summarized in the table below.

Aquifer Parameter	Parameter Value	Units	Source
Transmissivity	100,000 / 2	gpd/ft	AES Highgrove Project AFC (2006, Section 8.14.5.2)
Specific Yield	0.1	NA	Representative Textbook Value
Pumping Rate+	183	acre-feet/year	Proposed pumping rate
Pumping Time	10	years	Representative value for modeling the effects of long-term pumping

Groundwater flow gradient, up-gradient of onsite well	.0058	NA	Fall 1997 groundwater levels (Wildermuth Environmental, Inc., 2000)
Groundwater flow gradient, up-gradient of Spring Street well	.0071	NA	Fall 1997 groundwater levels (Wildermuth Environmental, Inc., 2000)

+ Rate per well. Assumes rate is time-constant, i.e., continuous long-term pumping is assumed.

2. Effects on groundwater contaminant migration were evaluated by calculating groundwater capture zone limits (i.e., flow divides) (Chow, 1964). The capture zone limits were overlaid on existing nitrate contours to evaluate effects on contaminant migration. The existing nitrate contours depict 1997 ambient nitrate concentrations.

3. The likelihood that changes in drawdown and contaminant migration will occur was estimated using professional judgment based on the above results.